

# PHOSPHORUS PRIMER

## PHOSPHORUS AND THE ENVIRONMENT

Phosphorus is a nutrient that is essential for plant life. When too much phosphorus is present in a stream or lake, growth of aquatic plants becomes excessive. In deep streams or lakes, the aquatic plants are algae and their overgrowth is called an algal bloom. Algal blooms can lead to several unhealthy environmental conditions:

- **High pH:** Because algae are plants, they engage in photosynthesis. The process of photosynthesis consumes carbonic acid that is dissolved in the water, making the water more alkaline. This is observable as an increase in pH. High values of pH can be harmful to many types of aquatic life, including fish and macroinvertebrates. To protect aquatic life, the State of Oregon has set a standard that the pH not exceed 8.5.
- **Low dissolved oxygen:** As long as the algae are alive and engaging in photosynthesis, they increase the amount of oxygen in the water. When the algae die, however, they decompose. The decomposition process consumes dissolved oxygen and can lead to dissolved oxygen concentrations that are too low to support desirable fish species such as salmon and trout.
- **Poor aesthetic quality:** Algal blooms decrease the clarity of water and cause it to appear green and unsightly. This is because algae contain chlorophyll, a natural pigment that is used in photosynthesis. Measuring the amount of chlorophyll in water is one way to estimate the amount of algae present. To protect aesthetic quality, the State of Oregon suggests that the chlorophyll concentration not exceed 15 µg/L.

## SOURCES OF PHOSPHORUS

Phosphorus is present in organic wastes and in natural minerals. It enters streams from a variety of sources, including:

- wastewater treatment plant effluent
- some industrial discharges
- runoff of fertilizers and manure from agricultural fields and residential yards
- runoff from streets
- erosion of soil and weathering of some rocks
- some soaps, detergents and other cleaners
- ground water that contains phosphorus dissolved from natural minerals

Wastes from point sources, such as wastewater treatment plant effluent and industrial discharges, are highly regulated and, for the most part, known and controlled. Wastes from nonpoint sources, such as runoff, are much more difficult to measure and control. The amount of phosphorus that is attributable to each nonpoint source is unknown.

## PHOSPHORUS AND THE TUALATIN RIVER

In the 1980s large algal blooms were common in the lower Tualatin River. These blooms led to frequent violations of the pH standard and poor aesthetic quality. In 1988, the Oregon Department of Environmental Quality developed a TMDL (Total Maximum Daily Load) for phosphorus in the Tualatin River. The TMDL is the concentration of phosphorus that scientists believe the river can assimilate and still be healthy. The 1988 phosphorus TMDL was set at 0.02–0.07 mg/L depending on location in the basin.

After 1988, studies by the US Geological Survey and the Oregon Graduate Institute found that groundwater in the some areas of the Tualatin Basin has phosphorus concentrations that are greater than the 1988 TMDL levels. Natural minerals that contain phosphorus are present in the rock and soil of the Tualatin Basin and these minerals dissolve in the local groundwater. The TMDL for phosphorus was updated in 2001 and reflects this new information. The 2001 phosphorus TMDLs vary across the basin (0.04 to 0.19 mg/L) and are believed to be the best available estimates of the local naturally occurring phosphorus concentrations.